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Computer-Aided Design AND APPLICATIONS

Application of Particle Swarm Optimization Algorithms in Landscape Architecture Planning and Layout Design

Yu Chen

School of Art and Design, Sias University, Xinzheng, Henan 451150, China,

Corresponding author: Yu Chen, 16227@sias.edu.cn

Abstract. At present, urban informatization has become an inevitable trend, and 3D CAD has entered a new period of rapid development and wide application. Based on ML (Machine learning) algorithm and CAD technology, this article discusses its application in landscape planning. On the basis of discussing and analyzing the data acquisition and preprocessing of urban 3D landscape model, a landscape planning and design model based on PSO (Particle swarm optimization) algorithm is proposed. In the model, this article improves the position updating formula and introduces the crossover operation of genetic algorithm, which increases the learning mode of population particles and improves the optimization ability of particles. Moreover, an improved random inertia weight selection strategy is proposed, which can effectively adjust the fishing ability of subgroups. The simulation results show that the RMSE, MAE and MAPE of this model are at a low level. Among them, RMSE is about 0.507, MAE is about 1.243, and MAPE is about 0.261. This method effectively improves the performance of the algorithm, improves the display speed and improves the 3D display effect. Compared with the traditional parametric design, the proposed method can automatically learn the rules of landscape architecture functional layout without adding rules artificially, and generate a more reasonable landscape architecture planning scheme, which can be used as a reference for professionals.

Keywords: Artificial Intelligence; Machine Learning; CAD; PSO Algorithm; Visualization; Landscape Architecture
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1 INTRODUCTION

Digital city has become the target of urban information construction. The "Digital City" project is in full swing in major cities. The 3D remote presentation system can achieve real-time collaboration, allowing users from different locations to simultaneously view and edit the same 3D model or scene. Through multi-person collaboration, team members can share a common workspace for discussion, collaboration, and decision-making in virtual, mixed, or augmented reality environments. Abdalla et al. [1] conducted virtual structured user tracking for 3D space aware environmental communication. It analyzed the differences in target orientation under the perceptual avatar function of point cloud reconstruction. Based on point cloud reconstruction, the user analyzed the role target avatar rating under objective indicators in a virtual environment. In virtual, mixed, or augmented reality environments, 3D remote presentation systems can use spatial perception technologies such as 3D sound effects and visual positioning, allowing users to more realistically experience their own and others' positions and actions. This can enhance the user experience and improve collaboration efficiency. Moreover, with the continuous growth of AI (Artificial intelligence) and computer technology, many computer technology theories, software products and physical equipment specially applied in the field of landscape engineering have emerged, such as BIM technology, CAD software, 3D digital animation platform, virtual reality interface, etc., which have provided assistance for the parametric growth of urban design. CAD design tools provide highly accurate measurement and calculation functions, which can help designers more accurately understand and analyze building structures. It can help designers better grasp the overall design concept, thereby optimizing the design scheme and reducing design flaws during the conceptual process. Asgari and Fathi [2] analyzed matrix structural evaluation in building environments. It used different tool selection factors to analyze the functional ambiguity of the improved construction tool project background. This visual design can better showcase the details and characteristics of architectural design, and improve customer satisfaction with the design scheme. At the same time, CAD design tools can also generate construction drawings and plans, enabling the construction team to have a clearer understanding of the requirements and progress of the project, thereby improving the quality and efficiency of the project. CAD is a technology that uses computer system to help generate, modify, analyze and optimize design. CAD and drawing are widely used as tools for designers to draw. With the extensive application of professional software in landscape engineering and the maturity of its technology, almost all designers of design institutes are now using computer drawing. CAD focuses on describing the artificial world and the graphic expression of spatial objects, which can describe a single 3D object with high precision. Moreover, CAD technology can improve the previous structural design methods and make it easier for designers to explore the design space. This technology can accurately calculate in a short time. According to the set constraint parameters or algorithms, a better structural form can be given through calculation, and a more optimized design solution can be proposed. Street view photo image segmentation based on deep learning is a method used to represent visual information. It can segment different objects and scenes in street view photos and represent them as pixel level labels. Bianconi et al. [3] focused on investigating and analyzing the correlation between visual perception and geographic image reference cognitive regions in landscape design. It conducted landscape testing of perceptual information through a quantitative set of element image testing theories. Choose a deep learning model suitable for street view photo image segmentation, such as U-Net, SegNet, etc. Then train the model, which requires the use of a large amount of labeled data for model optimization. After training the model, it is necessary to evaluate it to determine its performance and accuracy. If necessary, the model can be tuned to improve its performance. Use the trained model for image segmentation of street view photos. The result of segmentation can be a pixel level label image, where each pixel corresponds to a category of an object or scene. If necessary, post-processing operations can be performed, such as removing noise, filling voids, etc. Finally, the segmentation results can be visualized and analyzed. Different colors or symbols can be used to distinguish different objects or scenes, and analysis tools can be used to extract more information. By using deep learning based street view photo image segmentation, visual information can be represented as pixel level labels to better understand and analyze the information in street view photos.

Fang et al. [4] proposed a model training for urban professional intelligent planning guidance analysis based on deep learning networks. Integrating garden landscape planning intelligence into deep learning can use street network design planning as input, and predict garden landscape planning and design through deep learning models. Firstly, it is necessary to collect a large amount of data on street network design and landscape planning, including street network structure, landscape layout, architectural style, vegetation types, and other information. During the training process, optimization algorithms such as gradient descent and backpropagation can be used to adjust model parameters, enabling them to effectively learn the laws and features of street network design and landscape planning. Use trained deep learning models for predicting and classifying street network design and landscape planning. Firstly, input a street network design and landscape planning image to be classified, and use the predicted output of the model to determine which street network design and landscape planning type the image belongs to. Landscape has different meanings in different fields. In geoscience, landscape refers to natural and artificial surface scenery with aesthetic characteristics in a certain area. Landscape is a complex composed of topography, vegetation, water, natural phenomena, artificial structures and people. The spatial pattern of landscape ecotone is the main part of landscape planning, and it is the main embodiment of landscape context and spatial layout. As a data collection of points and other information, 3D models can be generated manually by 3D modeling tools or automatically by computers according to certain rules and standards. The modeling method based on CAD is to establish the corresponding 3D CAD model through some modeling software such as Auto CAD and 3Dmax. Among them, one or more multilateral models can establish a 3D CAD model, which can express the characteristics and attribute information of landscape in detail and accurately. At present, in the construction and application of digital city, people pay more and more attention to the fidelity and application ability of 3D city model. Felbrich et al. [5] analyzed the target specification manufacturing execution standards under computer building scale simulation. It constructs a sensor adaptability training planning standard for the construction industry. By analyzing the efficient geometric network compression of convolutional encoders, it complements the industry proxy application of CAD robots. Collect a large amount of data on the manufacturing of landscape building additives, including architectural design drawings, building structures, building materials, construction processes, and other information. These data are then preprocessed, such as cleaning, conversion and normalization, to meet the training needs of the Deep reinforcement learning model. Select an appropriate Deep reinforcement learning model, such as deep Q network (DQN) or Actor Critical algorithm, and use the pretreated data set for model training. During the training process, it is necessary to set appropriate hyperparameters and discount factors to adjust the balance between model exploration and utilization. In order to realize distributed modelless Deep reinforcement learning, an efficient computing environment needs to be set up. Post processing and optimization of the generated landscape building additive manufacturing results, such as removing noise, enhancing details, adjusting colors and contrast, etc., to make the results more in line with design requirements and actual manufacturing conditions.

Hussein [6] analyzed the potential AR applications of augmented reality in landscape architecture design. Integrating augmented reality technology into architectural education can provide students with a more vivid and practical learning experience, especially in landscape design courses. Through augmented reality technology, virtual landscape design models can be embedded into real scenes, allowing students to observe and interact with these models more intuitively. Through augmented reality technology, students can conduct simulation experiments in real scenes to test different design schemes and effects. For example, students can simulate the direction of water flow, changes in lighting, etc. in real scenes. In order to express the objects in the real world in more detail and improve the efficiency of computer management, it is need to establish some rules to describe the objective entities themselves and the relations between entities, which is called data model. Spatial data model is the cornerstone of data organization and database design in geographic information system. With the continuous development of CAD software technology, the process of CAD architectural education and design can also be improved. For example, new CAD software can provide more design tools and functions, such as intelligent design suggestions and automated design processes, which can greatly improve design efficiency and quality. The development process of garden architecture is influenced by many investigations and multiple technical factors. Its determination has affected the development of communication technology for the conceptualization of news in the investigation school. Imani and Asefi [7] share and use a large number of design resources and data through cloud computing and Big data technology, making the design process more efficient and intelligent. In the actual process of CAD architectural education design, it is also very important to continuously accumulate practical experience and apply it to the improvement and development of technology. Through practical experience in practical cases, design processes and methods can be continuously optimized, thereby promoting technological progress and development. Landscape modeling is to describe the landscape in the real world with a certain mathematical model in the computer. Urban 3D landscape modeling includes terrain modeling and ground object modeling. But in essence, landscape modeling should be divided into two parts: geometric modeling and texture mapping modeling. 3D model is to construct things by polygons, and output them through video equipment after computer processing. 3D model is not only a real entity, but also a virtual imaginary thing. In 3D urban model, digital photogrammetry can provide the following important data: spatial coordinates of landscape architecture and buildings, digital elevation model and digital orthophoto. Multispectral images can also be used to distinguish vegetation from artificially constructed objects in digital cities. Traditional 3D model rendering needs to configure model materials, lighting and other elements, and then get the results through complex operations, which often takes a long time and requires high computer hardware. The ML algorithm based on AI provides a new idea for image conversion. This article mainly discusses the application of ML algorithm and CAD technology in landscape architecture planning and design. Its main innovation lies in:

(1) This article proposes a learning strategy of adaptive mutation optimization and applies it to PSO algorithm. Moreover, an improved random inertia weight selection strategy is proposed, which can effectively adjust the fishing ability of subgroups.

(2) In the landscape planning model based on PSO algorithm, this article improves the location update formula, introduces the crossover operation of genetic algorithm, increases the learning mode of population particles, and improves the optimization ability of particles.

The main contents of this paper include the following parts: The first part is the introduction, which expounds the background of the topic selection. The second section is the introduction, which summarizes the relevant literature at home and abroad, and gives the research ideas and ideas of the paper. The third section expounds the visualization technology of urban 3D landscape in detail. The fourth section gives the concrete steps of applying particle swarm optimization algorithm to optimize landscape planning scheme. In the fifth section, the simulation results are given and compared with those of other algorithms. The sixth section summarizes the whole paper and puts forward the next research direction.

2 RELATED WORK

Jahani et al. [8] conducted an assessment of the aesthetic quality of ecological forest system landscapes based on human environmental perception. The aesthetic quality model of Multilayer perceptron is constructed. The optimal method for environmental assessment of forest broad-leaved landscapes in the dataset has been determined. The evaluation of the aesthetic quality of forest landscape is an important method for evaluating forest resources, which can be used to evaluate the aesthetic quality of forest landscape. Including information on vegetation, terrain, and topography of forest land. These data are preprocessed, such as image enhancement, Data cleansing and other operations, to improve the accuracy of the model. Using machine learning algorithms for feature extraction of forest landscapes. Feature extraction can be achieved through methods such as image recognition technology and computer vision technology. These features can include the type, density, color, etc. of vegetation, as well as the morphology and changes of terrain and landforms. Model training and evaluation Select the machine learning model suitable for the evaluation of the aesthetic quality of forest landscape, such as Convolutional neural network (CNN). Then train the model, which requires the use of a large amount of labeled data for model optimization. After the training is completed, the model is evaluated using a test dataset to determine its accuracy and reliability. It can achieve automated evaluation and prediction of the aesthetic quality of forest landscape, thereby helping forest management institutions better understand and protect forest resources. Machine learning technology can be used in automatic design and intelligent design in Garden design.

Through the deep learning algorithm, we can learn and simulate the creativity and aesthetics of designers, and achieve automated Garden design. At the same time, machine learning technology can be used to carry out intelligent layout and design of plants, buildings, landscape and other elements in the garden, so as to improve the quality and efficiency of Garden design. Jing et al. [9] analyzed the perspective of landscape architecture in landscape technology. It analyzes the model evaluation of deep learning algorithms in different fields for landscape digitization construction. By evaluating the landscape architecture of different garden scenes, a digital planning method based on intelligent technology was constructed. Michelle and Gemilang [10] conducted a three-dimensional digital software model for architectural landscape design. Display the generated street network design and landscape planning images to users, obtain user feedback, and iterate and optimize the model based on user feedback to continuously improve the generation effect and user experience. Post processing and optimization of generated street network design and landscape planning images. Through the above steps, intelligent landscape planning can be integrated into deep learning to achieve the planning and prediction of street network design. At the same time, other technologies such as virtual reality and augmented reality can be combined to provide users with a more intuitive and immersive experience. Deep green diagnosis is a technology that uses deep learning and UAV images to analyze Urban green space. Through this method, we can accurately identify and evaluate the Viridiplantae in the city, so as to realize the Sustainable city planning and environmental protection management. Moreno et al. [11] proposed urban planning guidance and street configuration based on deep learning networks. Use deep learning models for feature extraction. Through Convolutional neural network (CNN) or other deep learning models, green space features can be automatically extracted from images. Based on the classification or segmentation results, various indicators can be generated, such as green area, green coverage, and green health status. These indicators can be used to evaluate the greening status of the city and provide basis for Sustainable city planning. Quoc et al. [12] constructed a shallow recognition gradient feature histogram model for the algorithm of plant feature structure. By shallow recognition of deep convolutional networks, a framework for identifying landscape plant species was constructed. Firstly, a large number of plant leaf image datasets need to be collected. In order to enrich the dataset, different shooting devices, shooting angles, and lighting conditions can be used to obtain images.

Preprocess the dataset, including Image scaling, clipping, normalization and other operations, for the convenience of subsequent processing. Use directional gradient histogram feature space to extract features from leaf images. Directional gradient histograms can provide texture, edge, and other information of images, and can be used to distinguish different plant species. Before feature extraction, it is necessary to segment the leaf image and extract the leaf regions from the image. Convolutional neural network can classify and recognize leaf images, learn the features of leaf images by training neural networks, and map these features to plant species. Sarkon et al. [13] reviewed and analyzed the classification and evaluation analysis of additive quality technology design in machine learning. It considers the application of model limitations in process optimization algorithms for a complex additive product. Machine learning plays an important role in additive manufacturing, which can effectively improve the efficiency and quality of the manufacturing process, reduce costs and risks. With the continuous development of machine learning technology and the continuous expansion of application scenarios, the application of machine learning in additive manufacturing will become increasingly widespread and in-depth. Machine learning can be used for process control and optimization in additive manufacturing processes, such as adaptive control, intelligent scheduling, etc. By analyzing and processing data in the manufacturing process through machine learning algorithms, the manufacturing process can be adjusted in real-time to improve its stability and efficiency. The current volume of 2D garden design for artificial intelligence deep learning related adversarial network image quality is limited. In particular, the project design of floor layout is carried out by using the deep learning Computer-aided design. Senem et al. [14] utilized a matching structure model of image quality to perform functional evaluation on the dataset. A development framework for image structure was constructed through quantitative analysis of garden layout. Use a trained deep learning model to generate tasks. Firstly, input a random noise vector or user provided input, input it into a deep learning model, and generate an image of a garden landscape architecture through the predicted output of the model. Perform post-processing and optimization on the generated garden landscape architectural images, such as removing noise, enhancing details, adjusting colors and contrast, to make the images more realistic and aesthetically pleasing. Display the generated garden landscape architectural images to users, obtain user feedback, and iterate and optimize the model based on user feedback to continuously improve the generation effect and user experience. Xia et al. [15] conducted a complex fuzzy judgment of residential architectural style. By using linear site positioning and economic factor planning, the color tone training of economic factors was conducted on the form variables under the real estate landscape specifications. When the architectural form style is used to change the volume, it conducts a complex fuzzy investigation on the data analysis of the real estate project. Select appropriate machine learning models, such as support vector machine (SVM), decision tree, Random forest, etc., and use the extracted features for model training. During the training process, techniques such as cross validation can be used to improve the model's generalization ability and prediction accuracy. Evaluate the trained machine learning model, such as measuring its effectiveness through indicators such as accuracy, recall, and F1 score. If the model performs poorly, methods such as adjusting model parameters and increasing regularization can be used to improve the performance of the model.

The landscape design of the building environment directly affects the ecological performance of the building itself. In the past, there were many obstacles and non-analytical factors in the sustainable design of architectural landscapes. CAD tools can help architects maximize the use of Renewable resource in their design. Help architects to consider the quality of indoor environment in their design. The structure and layout of buildings shall be designed reasonably to provide a comfortable indoor environment and ensure the stability of natural lighting, natural ventilation and indoor temperature. Yu et al. [16] reduced the impact of buildings on the environment by using environmentally friendly materials, optimizing the structure of buildings, designing rainwater collection systems, and green roofs. By simulating and analyzing the life cycle cost, environmental impact, and performance of buildings, determine their sustainability and optimize them. In short, CAD tools can help architects consider sustainability factors in their design and achieve the sustainability goals of the building by optimizing the design. Zeng et al. [17] analyzed the overall value preference for applied conservation of forest landscapes. By analyzing the landscape preference of the avenue, a high-precision plan view model was constructed. Use a trained model to analyze the forest landscape preferences of Chinese forest tourists. By inputting forest scene photos into the model, it is possible to predict the level of preference of tourists towards different forest scenes. At the same time, it is possible to analyze the landscape characteristics preferred by recreational users, such as vegetation density, terrain, and topography. By inputting photos of recreational individuals in forest scenes into the model, it is possible to predict their emotional state in the forest, such as pleasure and relaxation. At the same time, factors that affect the emotional state of recreational activities can be analyzed, such as climate, scenery, etc. Zhang et al. [18] proposed strategy optimization for public perception of Urban green space. It analyzed the semantic testing status visual variable results of the landscape architecture evaluation framework. In the analysis of adaptability factors in emotional visual testing of landscapes, there have been significant changes in the emotional creation framework of urban planning. Real time monitoring and evaluation of urban design using trained models. Obtain urban design data through Internet of Things technology, sensor technology, and other means, and input these data into deep learning models for prediction and evaluation. The evaluation results can include indicators such as emotional health index and resident satisfaction. Based on the evaluation results, feedback and optimization suggestions for urban design can be obtained. By analyzing feedback data and optimizing suggestions, urban design can be further optimized to improve residents' emotional health levels. Through a collaborative deep learning framework for emotional health oriented real-time landscape evaluation in urban design, real-time monitoring and evaluation of urban design can be achieved. And receive feedback and optimization suggestions to help urban designers better understand the advantages and disadvantages of urban design, and further improve the emotional health level of residents.

In this article, the basic theory of 3D visualization of digital city is discussed, and driven by AI, a landscape planning method based on PSO is proposed, which realizes the visualization and browsing of 3D model of landscape planning.

3 VISUALIZATION OF URBAN 3D LANDSCAPE

Urban 3D landscape CAD visualization is a technology that utilizes computer-aided design (CAD) technology and 3D visualization technology to visualize and display urban 3D landscapes. Through this method, the spatial layout and landscape effect of the city can be more intuitively felt, providing strong support for urban planning and design. Firstly, it is necessary to collect relevant data about the city, including terrain, buildings, roads, greenery, etc. These data can come from various sources, including field measurements, map data, satellite images, etc. Use CAD software to conduct 3D modeling of the collected data. This process can include terrain modeling, building modeling, road modeling, greening modeling, etc. Import the established 3D model into visualization software for virtual display. This process can include adjusting the position, size, angle, etc. of the model to achieve the best display effect. By designing an interactive browsing interface, users can freely browse the three-dimensional urban landscape. This can include operations such as flying, rotating, and zooming to provide users with a more comprehensive understanding of urban planning and design. For established 3D landscape models, they can be updated and modified at any time. This can help urban planners adjust their planning and design plans in a timely manner to achieve the best results.

Through CAD technology and visualization technology, design intent can be expressed more accurately, thereby improving the efficiency of planning and design. Through virtualization, problems in planning and design can be identified and resolved in the early stages, thereby reducing costs and risks in the later stages. Through interactive browsing, decision-makers can have a more intuitive understanding of the effectiveness of urban planning and design, thereby improving decision-making efficiency. Through visualization technology, the effectiveness of urban planning and design can be demonstrated to the public, thereby improving public participation and satisfaction. In short, urban 3D landscape CAD visualization technology can provide strong support for urban planning and design, promoting sustainable development and ecological civilization construction of cities.

Due to the continuous improvement of people's requirements for living environment, the difficulty of landscape architecture planning and design is also increasing. Auto CAD is a powerful software that is easy to learn and use. Moreover, it is also the earliest and most widely used designer software. It can best reflect the superiority of CAD, which greatly reduces the labor intensity of designers and shortens the design cycle. The software can form entities through various basic geometric figures, and then construct different geometric scenes through basic geometric transformation. When using CAD software to build 3D models, the core is to use geometric modeling to design and express some virtual scenes and shapes. Using CAD technology, the planning and layout scheme of landscape architecture can be intelligently generated for designers' reference, which brings more convenience to designers and is conducive to improving the efficiency of landscape architecture planning and design.

At present, urban 3D landscape rendering technologies are mainly divided into two categories: graphics-based and image-based rendering technologies. The advantages of graphics-based rendering technology mainly include: high sense of reality, easy association with related spatial attribute information, and simple establishment of topological relationship in 3DGIS. Image-based 3D rendering technology overcomes the shortcoming of large amount of data in geometric model, and replaces geometric solid model with images with rich texture information, thus constructing a more realistic 3D landscape with less data. 3D visualization is to show images in 3D. A complete

3D visualization process includes modeling process, mapping process and interaction process. After modeling, all kinds of urban spatial entities need to undergo a series of necessary transformations before they can be realistically displayed on the computer screen. It generally includes several steps such as scene modeling, coordinate transformation and projection transformation, eliminating hidden surfaces and hidden lines, shading, color and texture generation, drawing and display. 3D visualization spatial information, including data acquisition, ground orthophoto acquisition and texture data acquisition, is the display of 3D visualization model and the basic project of virtual reality construction. The object-oriented spatial data model is shown in Figure 1.

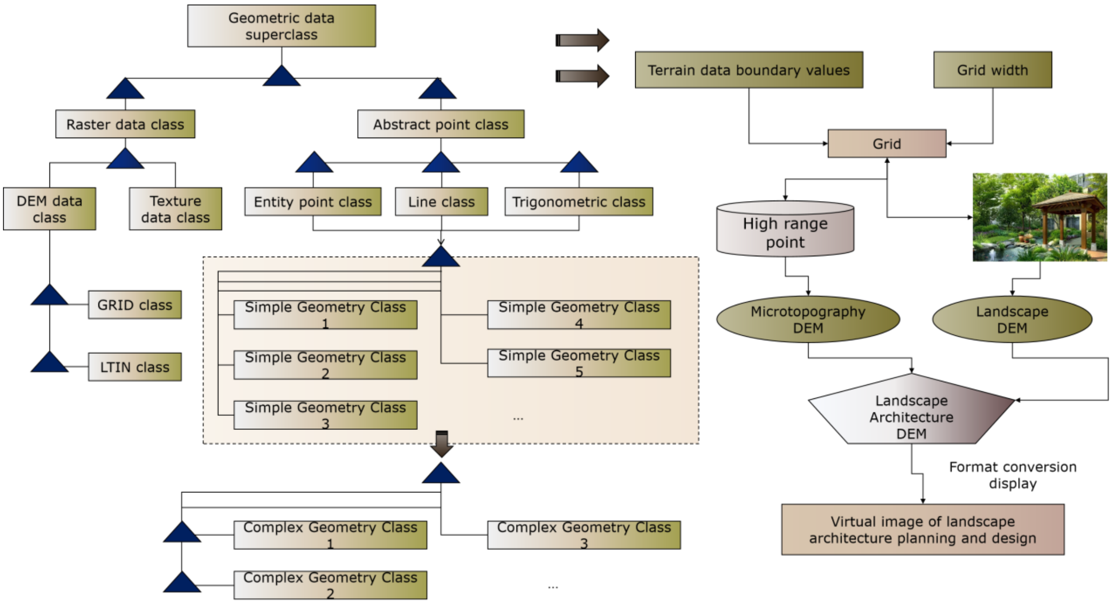

Figure 1: Object-oriented spatial data model.

Traditional landscape design models require a significant amount of manpower, material resources, and time for data collection and modeling. Image based 3D rendering technology can quickly and low-cost data collection through devices such as drones or cameras, and automatically generate landscape models using 3D rendering technology, thereby reducing the cost of data collection and modeling. Due to certain errors in the data sources and modeling methods of traditional landscape design models, the accuracy of the models is often not high enough. Image based 3D rendering technology can achieve high-precision 3D model rendering through image processing and computer vision technology, improving the accuracy and accuracy of the model. Traditional landscape design models often require a significant amount of time and effort to update and maintain. Image based 3D rendering technology can achieve real-time updates, that is, as long as the original image is updated, new 3D models can be quickly generated, saving a lot of update and maintenance costs. Traditional landscape design models may have some distortion, resulting in a lack of realism in the model. Image based 3D rendering technology can achieve high realism 3D model rendering through image processing and computer vision technology, making the model more realistic and vivid. Therefore, image-based 3D rendering technology can improve the efficiency, accuracy, and realism of landscape design models, while reducing costs and risks, providing more comprehensive and accurate support for landscape design and urban planning.

The CAD design of 3D landscape architecture takes landscape design as the theme, and can dynamically browse the scene in OpenGL. It can also make realistic renderings and 3D simulation cartoons in real time to show the scene from all directions and angles. When storing data, because the 3D model has a huge amount of data and complex structure, it is need to use professional software to establish a database, such as Oracle, SQLServer, Sybase, DB2 and Infomix. After storing the data in the database, the model can be visualized by 3D software. In addition, landscape architecture planning and design renderings are not only one of the important means to express the final results of landscape architecture planning, but also provide reference for designers to scrutinize the scheme in the design stage. The traditional rendering of landscape architecture planning renderings requires the configuration of materials, lighting, plants and other elements of 3D models, and then the realistic renderings are rendered through complex algorithms. This method not only takes a lot of time, but also usually requires high-performance computer hardware support. ML algorithm based on AI provides a new idea for image conversion.

4 LANDSCAPE ARCHITECTURE PLANNING AND DESIGN BASED ON PSO ALGORITHM

This article is based on PSO algorithm for landscape architecture planning and design. Swarm intelligence algorithm usually refers to an algorithm that simulates natural processes to solve complex engineering problems. These algorithms have the characteristics of group search, multi-process parallelism, self-adaptation and self-learning, and replace traditional algorithms to solve complex optimization problems with multiple extreme values and high dimensions. In PSO algorithm, each particle has not only its own historical experience but also the historical experience of the whole group, and by analyzing these experiences, it finds the position that is considered as the best value, and then decides its next move. In the stage of iterative optimization, particles will determine their moving path in the search space through four factors. These factors are: the current position of the particle itself, the historical optimal position of the particle, the position of one or more optimal particles in the group, and random disturbance. Only after all particles in the population have successfully completed a movement, the population will complete a complete iteration.

The search stage of PSO is mainly the change of its speed and position in different dimensions. The fitness function of particles is the minimum mean square error:

$$MSE = \frac{1}{P}\sum_{i=1}^{P}\sum_{l=1}^{N}\left(t_l - O_l\right)^2 \tag{1}$$

Where N is the dimension of the output vector and P is the total quantity of samples. The initial population is divided into several niche subgroups and the particle fitness is calculated. Then calculate individual extremum, group extremum and total extremum, fitness calibration and adaptive adjustment of inertia weight, and update particle speed and position. If the niche updating condition and the maximum quantity of iterations are reached, the network connection weights and thresholds are determined. The connection weights w_{ij} and w_j to be optimized, the scaling factor a_j and the translation factor b_j are taken as the position vector of each particle. which is:

$$present(m) = \left[w_{ij}, w_j, a_j, b_j\right] \tag{2}$$

Among them, m is the quantity of particle swarms. Calculate the initial fitness value as follows:

$$F = \sum_{i=1}^{n}\left|y_i - h_i\right| \tag{3}$$

If the weights are selected properly, the search ability of PSO algorithm can be greatly improved. The inertia weight value is used to represent the inheritance of the current velocity of particles, and the balanced exploration and development ability of particles benefits from the reasonable selection of inertia weight. It can be seen that the original PSO is a special case with inertia weight of 1. The PSO steps are shown in Figure 2.

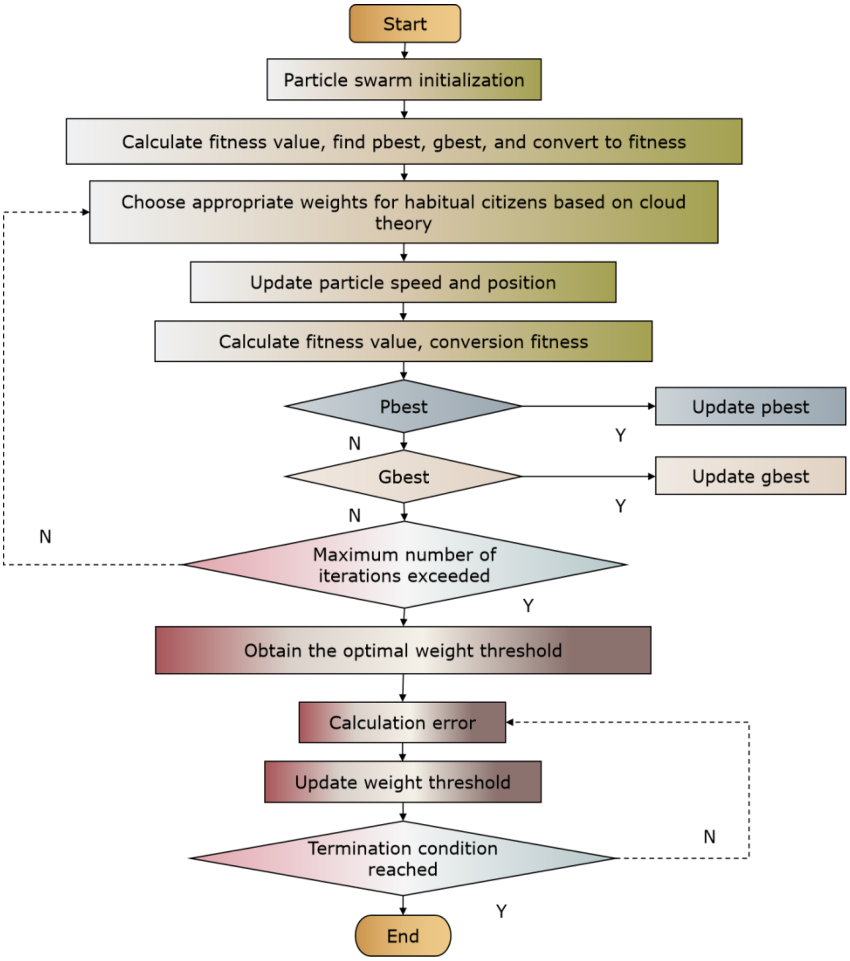

Figure 2: PSO steps.

At present, the improved PSO algorithm is generally aimed at strengthening the local search ability or the global search ability. The algorithm that strengthens both local and global search capabilities can easily lose the control of balancing search capabilities, which eventually leads to the fact that the algorithm only strengthens some capabilities in essence and does not give full play to the characteristics of PSO algorithm. In this article, an adaptive mutation optimization learning strategy is proposed and applied to PSO algorithm. In the rational planning principle of garden-style Landscape layout, the initial flight speed of particles and the inertia weight of particles are calculated; the rational planning objective function of Landscape layout is calculated; the current position and flying speed of particles are updated according to the objective function; The optimal solution for rational planning of Landscape layout. Assuming that the positions of the particles are distributed arbitrarily, n particles are initialized, and they perform flight search in the garden-style Landscape layout space. The initial flight speed of the particles can be for:

$$v_{xp} = rand * v_{x\max} \tag{4}$$

$$v_{yp} = rand * v_{y\max} \quad (5)$$

v_{xp} and v_{yp} represent the flying speeds of the particles in the horizontal and vertical directions, $v_{x\max}$ and $v_{y\max}$ represent the maximum control speeds of the particles in the horizontal and vertical directions, and p represents the quantity of particles. Calculate inertia weights:

$$\omega(t) = \omega_{\max} - t * (\omega_{\max} - \omega_{\min}) / I_{\max} \quad (6)$$

Among them, $I_{\max}$ is the largest quantity of iterations, $\omega_{\max}$ is the largest inertia weight, and $\omega_{\min}$ is the smallest inertia weight. t represents the quantity of iterations. At the beginning of the iteration, a relatively large weight can enhance the global query performance of the particle swarm, that is, the optimal position can be roughly positioned quickly, and the later stage of the iteration can be carried out. Relatively small weights can enhance the local query performance of the particle swarm method. Calculate the fitness value of each particle:

$$D_k = \sum_{i=1}^{N} c_{ik} x_{ik} \quad (7)$$

$$S_k = \min_{i=1} (s_{ik} x_{ik}) \quad (8)$$

$$Z_k = \sum_{h=1}^{N} l_{ijh} x_{ik} \quad (9)$$

$$F = (D_k, S_k, Z_k) \quad (10)$$

F is the comprehensive evaluation value of multiple targets, D_k is the greening change cost target, S_k is the ecological adaptation target of the k th Landscape layout type distribution, and Z_k is the compactness of the greening unit, that is, the shape target. PSO algorithm controls the speed and direction of particles, and particles can move in the best direction. The realization of this process needs a certain adjustment time. In this article, the position updating formula is improved, and the crossover operation of genetic algorithm is introduced, which increases the learning mode of population particles and improves the optimization ability of particles.

5 EXPERIMENT AND RESULT ANALYSIS

This section carries out simulation experiments. After collecting enough landscape pictures, process them in the required format. When processing, Python tools are used to preprocess the images, and OpenCV is used to cut the collected images in batches to delete redundant information. Moreover, image processing tools are used to remove useless text labels and other information in landscape architecture drawings, and non-functional landscape architecture plans are made, and the quantity of samples is expanded by means of mirroring and rotation. In this algorithm, the initial inertia weight is at the maximum, which maximizes the global search ability of the algorithm and improves the convergence speed of the algorithm. In the medium term, the rapid transition, the rapid attenuation of inertia weight, the weakening of global search ability and the enhancement of local development ability; Maximize the local development ability in the later stage, improve the convergence accuracy of the algorithm, and achieve the effect of joint optimization of global optimization and local optimization. Figure 3 shows the change stage of the optimal individual fitness value in the optimization stage.

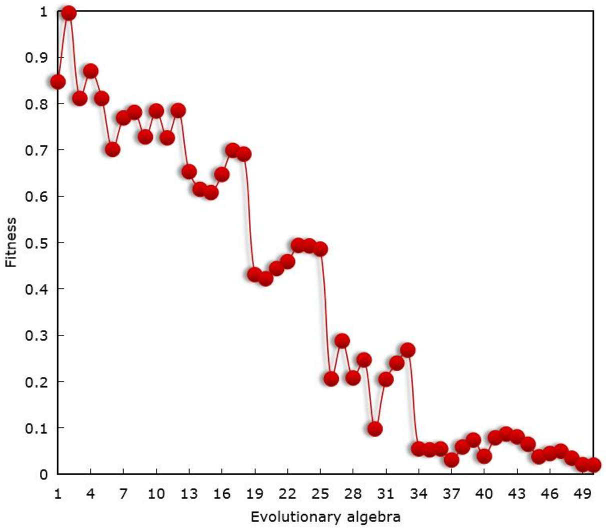

Figure 3: PSO process with adjustable inertia weight.

From the optimization process given in Figure 3, it can be seen that PSO has strong optimization ability, and the speed of the algorithm is faster in the initial iteration.

The training stage is repeated on the basis of avoiding precocity until it produces an error that meets the requirements or exceeds the preset calculation times. The weight set obtained at the end of the algorithm is the final result. The training Loss curve of the proposed algorithm is shown in Figure 4.

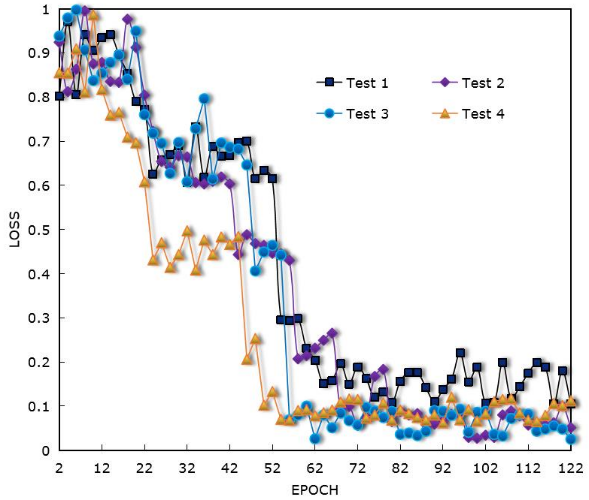

Figure 4: Training Loss curve.

The algorithm model is iterated until it reaches the maximum quantity of iterations or obtains the optimal solution. In the iterative era and when the data exchange process has ended, the convergence rate and analysis and processing ability of the proposed algorithm are gradually improved, so that users can carry out detailed massive data collection and search in the area near the best solution problem and solution scheme. Using the trained model, taking the landscape map as input, the landscape planning design with spatial layout is generated according to the contour of the input landscape map. The training stage inputs the images in the learning sample set. Figure 5 shows the training stage and results of landscape architecture design images.

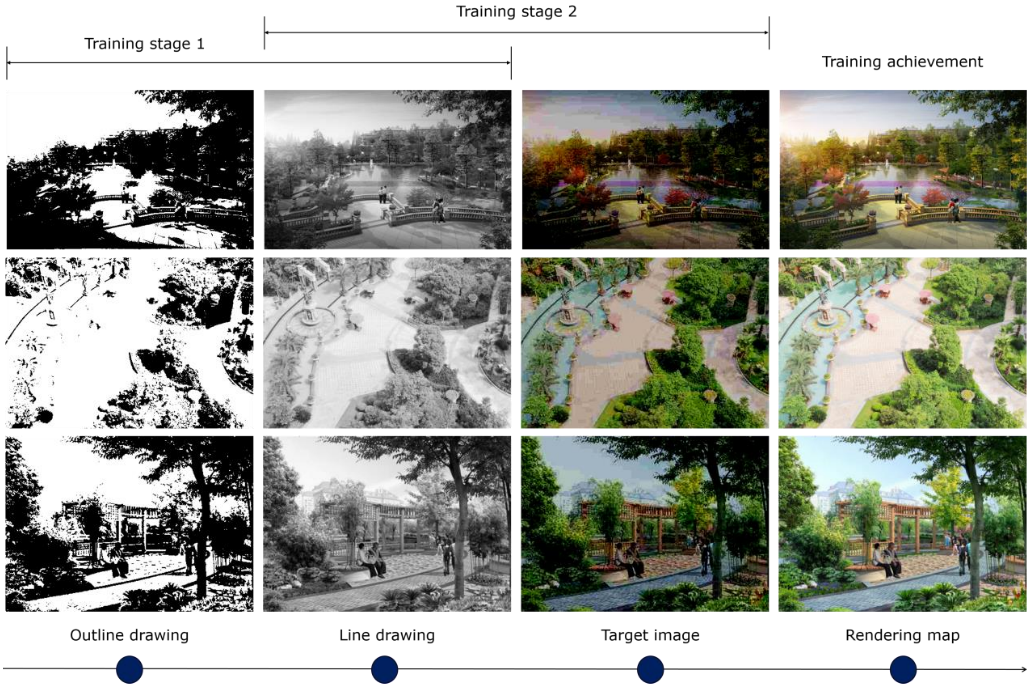

Figure 5: Training process and training results.

At the beginning of the whole particle gradient optimization, particle gradient optimization should be able to search the whole particle interpreter space quickly. In the later stage of the whole particle gradient optimization, we should pay more attention to the different convergence and structure of the whole PSO, so that we can search easily and quickly in the future and find the optimal solution quickly.

In order to objectively evaluate the performance of landscape architecture planning and design model based on PSO algorithm, the following experimental analysis is made on the algorithm model from the angle of error. The test samples are tested on the trained PSO model, and the output results of several different models are compared. The RMSE of different models is shown in Figure 6. The MAE of different models is shown in Figure 7. MAPE of different models is shown in Figure 8.

Combined with the above results, RMSE, MAE and MAPE of this method are at a low level, and the error is improved. Among them, RMSE of the proposed method is about 0.507, MAE is about 1.243, and MAPE is about 0.261. The test results show that the performance of PSO is better than other intelligent algorithms, and it has high practicability and reliability.

6 CONCLUSIONS

Landscape architecture design is a stage of close combination of aesthetics and technology, science and environment. This article mainly discusses the application of ML algorithm and CAD in landscape architecture planning, and puts forward a landscape architecture design model based on PSO algorithm.

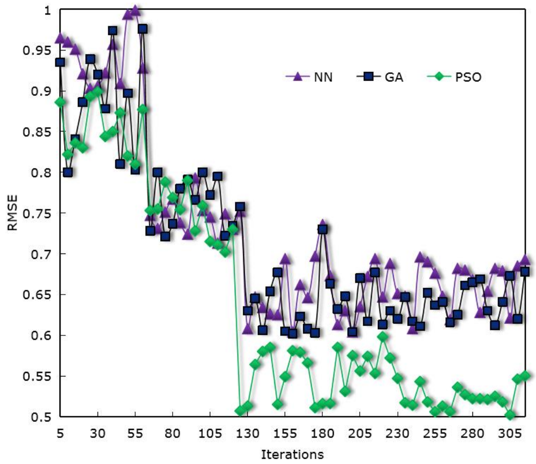

Figure 6: RMSE situation of different models.

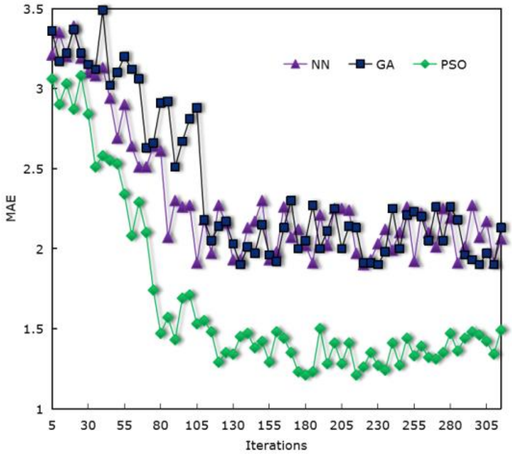

Figure 7: MAE situation of different models.

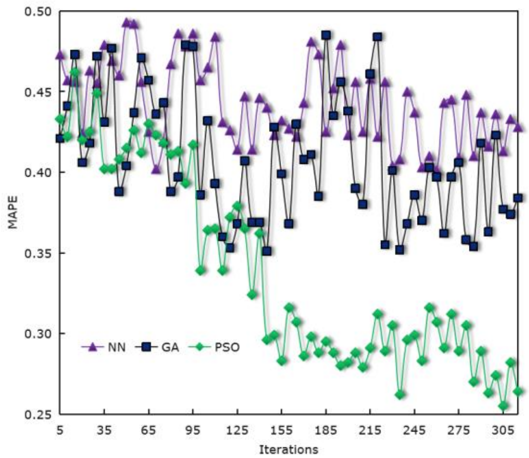

Figure 8: MAPE situation of different models.

In this model, the position updating formula is improved and the crossover operation of genetic algorithm is introduced, which increases the learning mode of population particles and improves the optimization ability of particles. Moreover, in view of the fact that the previous improved algorithm only strengthened part of the ability, it did not give full play to the characteristics of PSO algorithm. In this article, a learning strategy of adaptive mutation optimization is proposed and applied to PSO algorithm. The final results show that the RMSE, MAE and MAPE of this model are at a low level. Among them, RMSE of the proposed method is about 0.507, MAE is about 1.243, and MAPE is about 0.261. The test results show that the performance of PSO is better than other intelligent algorithms, and it has high practicability and reliability. It is practical and feasible to apply the PSO algorithm proposed in this article to landscape planning and design. However, this article also found some problems. This may be caused by the following reasons: the quantity of training sets and the quantity of training rounds, the more machine training, the more accurate the learning of pictures will be. The above problems will be further discussed in the future to further improve the performance of the model.

Yu Chen, https://orcid.org/0009-0007-6523-2231

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